PC

RESTRICTED CIRCULATION

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Agricultural Memorandum 851. Foot and Mouth Disease by J. Gloster

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1. Introduction

The object of this report is to present in one document all of the relevant information, for the meteorologist, on foot and mouth and so help him understand the background of the disease and to define his important role in the event of an outbreak.

Foot and mouth is a highly infectious viral disease which affects cattle, sheep, pigs, goats and deer. Wild ruminants and hedgehogs are also susceptible to natural infection with foot and mouth and the disease has also been reported in rats. Men have also caught it but this situation is so rare that it certainly does not play any role in the maintenance and spread of the disease.

Foot and mouth is feared not for its mortality rates which are only about 5% in adult animals, greater in young cows, but for its after-effects. These after-effects are especially serious in dairy cattle and include loss of milk production, abortion, sterility, heart conditions and secondary infections on the hooves and udder. This represents an unacceptable loss in revenue to the farmer and it is therefore necessary to prevent this disease from becoming established in Great Britain and in the event of an outbreak to eliminate it as quickly as possible.

2. The Virus

The virus, one of the smallest known, is about 24.10^{-9}m diameter. Seven virus types have been identified throughout the world. Types O, A, C have been responsible for most outbreaks in Great Britain and South America while types SAT1, SAT2, SAT3 and ASIA1 have been confined to Africa and Asia. Each type has also several sub-types.

One of the most important aspects of the virus is its ability to survive for long periods outside the host animals. In the laboratory it has been shown that the virus can survive for at least two weeks on wool, four weeks on cow hair, eleven weeks on boot leather, fourteen weeks on rubber boots and fifteen weeks on hay.

The factors which affect virus survival are relative humidity, pH of its immediate environment, temperature and ultra-violet light. The virus stands the best chance of survival if the relative humidity is greater than 60%. The pH of the air can influence the life span of the virus but the precise values are not accurately known. It is known, however, that the virus can be destroyed by high levels of pH. The temperature plays a secondary role in the survival of the virus and it has been shown that temperatures up to 27°C cause no deterioration in the virus. Low temperatures, even below zero, preserve the virus. Ultra-violet light can kill the virus but experiments in summer sunshine have shown that there are insufficient levels of ultra-violet light to have any marked effects on the virus.

3. Introduction of the virus into Great Britain

Knowing the above factors makes it easy to understand why imports of meat products from affected countries eg.Argentina have been thought to be the major route of virus introduction into Great Britain. The virus is preserved in the bone marrow, kidney and lymph glands but destroyed due to a change in pH in the rest of the body, after slaughter and subsequent deep freezing. The meat has then been imported into Great Britain and sold to the general public. In the past many swill feeders have collected the waste from restaurants, including the infected bones and fed it untreated to their animals. To prevent this, as a means of access of the virus into Great Britain, all meat that now enters from infected areas has to be boned prior to entry and swill feeders have to sterilize all swill before it is fed to their animals.

In these days of modern travel and international farming, another way that the virus may enter this country is by humans, who can unknowingly become carriers of the virus. A farmer or tourist can travel from an affected country and bring with him some of the virus on his boots or clothing. The farming community is aware of the problem and endeavours to take the corresponding precautions, but it is not inconceivable that the virus could enter by this means.

Whilst meat imports are controlled tourists bring into the country samples of paté and salami etc. from their travels and if these have not been cooked properly the virus may still be present. If these then find their way to the animals an epidemic may start.

Free movement of animals in and around the EEC may in the future cause concern because not all of the member countries are free from the disease.

The virus may also be introduced into Great Britain in an aerosol form. This aspect will be treated under the transmission of the virus section. There have been recorded cases where this has been thought to be the cause of an epidemic in countries separated by miles of sea. This route, although possible, is now greatly reduced since most of our neighbouring countries in Europe have almost eliminated the disease.

4. Infection and incubation

An animal can become infected by the virus in one of three ways; inhalation, ingestion or direct contact with infected material. Theoretically an animal only needs one virus particle to become infected but in practice a minimum infecting dose is required. Figure 1 shows the approximate numbers required to reach this level by inhalation and ingestion. Following the initial infection there is a short period known as the latent period during which no virus, or at least no measurable virus is released. However, the virus multiplies inside the animal during this time. The total incubation period can last from three to fifteen days with an average period of five to seven days. These times vary from virus to virus and from animal to animal. Prior to any physical symptoms being evident milk and other samples can show the presence of the disease. Figure 2 shows the time scales of the incubation period, infectious period etc.

5. Spread of the virus

Once one animal has contracted the disease it is only a short time before other animals in the herd and neighbouring herds also contract the disease. The virus is passed to the other animals in two stages. Firstly the infected animal emits the virus and then secondly it is carried to other animals either by physical contact, or as an aerosol or by other carriers.

5.1 Emission of the virus

Prior to the clinical symptoms becoming evident the virus is emitted by the infected animal. The virus can be emitted in aerosol particles, milk, urine, semen, faeces, in the fluid of ruptured blisters or through the skin.

The aerosol particles come mainly from the lungs or respiratory tract and are mainly emitted through the animals nose. Size measurements on these particles have shown that they range in size from approx. 3µm to 10µm diameter. 65-71% are greater than 6 µm, 19-24% between 3-6 µm and 10-11% less than 3 µm. This means that the majority of particles carrying virus will be greater than 5 µm.

It is believed that these particles may contain more than one virus particle surrounded by mucus fluid.

The majority of the aerosol is emitted by sheep and cattle in four days and pigs in five days although there is evidence to suggest that 50% of recovered cattle excrete up to 8 months after infection, 50% of sheep continued to be carriers at 8 weeks and pigs showed no persistence at all.

The maximum levels of virus excreted as aerosols are shown in Figure 3. This shows that pigs are the most prolific emitters of the virus.

The virus can also be released in aerosol form when infected faecal slurry is sprayed over a field. It has been estimated that, under favourable conditions, the disposal of 10 tons of faeces in 20 minutes would allow approx 10^7 virus particles to become airborne.

Some particles are released into the air from the break-up process of the animals saliva when it leaves its mouth and a background level is emitted through the body and taken into the air by the air currents.

5.2 Transmission of the virus

The aerosol once it is airborne behaves like other aerosols present in the atmosphere. If its radius is large, greater than 20 μm diameter approximately, and turbulence is very small the particles will fall to the ground but if it is smaller than this it may survive in the air for many days. Dependant upon the humidity, concentration and size of the total aerosol the emitted particles may evaporate some or all of their fluid, or coagulate with other particles. It is therefore very hard to define the exact size of the virus-carrying aerosols that exist in the atmosphere.

These aerosols are then carried by the wind and are subject to both horizontal and vertical spread. The vertical spread is smallest in stable meteorological conditions, i.e. with an inversion, and the horizontal spread is a function of the wind structure, which in turn is affected by the temperature lapse rate. Under stable conditions with no wind a large concentration of aerosol particles may build up but not be able to travel very far in a given time. However if the wind is strong and variable in direction the particles may be spread over many square miles but in very much diluted concentrations.

The rate fallout of these particles is greatly increased when they are captured by larger particles or droplets. The efficiency of the capture process, in general, increases with particle size and also with the rate of rainfall. Figure 4. (Smith and Jones, 1969) shows the relative rates of fallout under different weather conditions.
The diagram assumes an initial deposition of 1000 for dry deposition 1 km from the source and a wind speed of 11 M.P.H. The deposition, in rain, at twenty kilometres is ten times as great as in dry weather. It is also apparent that light rain or drizzle is the most favourite for deposition at long distances.

It has been demonstrated that the animals require lower numbers of viruses to become infected by inhalation than by ingestion but this must be balanced against the fact that the concentration of viruses on the ground are far greater in an area which has had rainfall.

6. Detection of the Disease

The disease can be detected fairly quickly in the case of milking herds because the animals are seen regularly and any reduction in performance or state of health is soon noticed. Animals that are inspected, as individuals, far less frequently eg moorland sheep are far more likely to have the disease in an advanced state than the milking herds. These present a larger problem in the elimination of the disease because of the amount of aerosol that has been produced and released into the air before the disease has been diagnosed.

A further complication is that some animals, especially sheep, will show no obvious signs of the disease and therefore act as a 'silent' source of the infection.

7. Symptoms of the disease

The first indication of infection in cattle is often dullness and depressed appetite. Temperatures rise quickly to 40-41°C and the animal begins to produce large quantities of saliva which hangs in strings from its mouth. The major clinical symptoms of the disease are blisters or lesions which appear on the tongue, lips, inside the mouth, on the udder or teats, on the nostrils and somewhat later on the feet generally between the claws or hooves. The lesions rise rapidly and burst leaving raw ulcer-like areas. These must be painful for the cattle because they frequently lick their lips, yawn, become restless, shuffle their feet and often go lame. These symptoms apply in general to sheep and pigs but there are slight differences in the saliva production etc.

8. Termination of the disease

The official method used in Great Britian to terminate the disease is to slaughter and bury or burn the infected carcasses as quickly as possible. To avoid contact spread the movement of stock is prohibited and strict hygiene is observed by all personal in the infected area. Vaccine is available, for unaffected animals, once the virus is identified but it takes seven days before it becomes effective. All sheep and cattle, more than three months old, could be vaccinated. Pigs would be excluded since they, like young sheep and young cattle, are difficult to immunize. It is thought economically advisable not to vaccinate as a standard practice because the number of outbreaks of the disease are fortunately small.

The disease probably dies out due to three reasons; firstly the slaughter of the animals leads to subsequent depopulation of susceptible livestock; secondly as an epidemic continues the virus appears to become less virulent; and thirdly the presence of the disease is determined far more quickly than at first and this means that less virus is emitted.

9. References

Smith, L.P., and Hugh-Jones, M.E., Nature, Vol 223, August 16, 1969.

PART II METEOROLOGICAL ACTION IN THE EVENT OF A FOOT AND MOUTH OUTBREAK

1. Epidemiology Team (ET)

A member of the Met O 8a duty roster, consisting of HSO/SSO's, is available at short notice to become part of an advisorary team, formed by the Ministry of Agriculture, Fisheries and Food, based near the scene of the outbreak. The team consists of:-

1 District Veterinary Officer (DVO) - in charge of the ET - MAFF.
1 Veterinary Research Officer - Animal Virus Research Institute (AVRI).
1 Technician - " " " "
1 Cattleman/Driver - " " " "
1 Meteorological Officer (HSO/SSO) - Meteorological Office (Met O 8a).
2 Weather observers (ASO/SO) - Meteorological Office - arranged by Met O 10.

The main objectives of the ET are:-

(a) To determine the extent and pattern of infection on the farm, particularly in relation to the weight of infection in the different species.

(b) To provide information on the possible origin and date of introduction of the infection.

(c) To assess the probable danger from the infected farm as a source of infection for the area, both in respect of the number of animals affected and of the local meteorological conditions.

(d) To advise the RVO in charge of the centre, based on the assessment made in (c), on the taking of samples from contiguous or other herds; eg.milk samples taken from contact herds may provide useful information in that it may be possible to isolate the virus some hours before the disease become apparent.

The Meteorological Officer's role will be to supply the necessary information so that (c) may be accurately determined. If there is a lack of local weather observations a mobile weather station, maintained at Met O 4, Western Road, Bracknell, will be transported by the Animal Health Office to the outbreak area. This equipment should be sited near to a telephone, and not on a livestock farm. The contents of the mobile weather station are listed in Appendix 1. If the mobile weather station is used Met O 10 will supply, from a list of volunteers, two people to operate it. In the event of subsequent outbreaks the observing station may be moved to a more representative site.

The DVO in charge of the control centre arranges overnight accommodation for the ET and also ensures that each team member receives whatever assistance is necessary. The meteorologist, at the control centre will be provided with exclusive use of one large table (at least 6 feet x 3 feet) and a telephone. Arrangements will also be made to supply a caravan for the weather observers. This caravan will be 14-15 feet long and have working tops, cooking, heating and temporary sleeping facilities. It is not intended that the weather observers should use the caravan as permanent accommodation.

The ET will remain at the control centre for as long as the team leader requires. If this period is greater than three weeks the Meteorological section of the team will be replaced by a backup team.

2. Procedure to be adopted if there is a suspected/confirmed outbreak of foot and mouth

A simplified flow chart, Figure 5., shows the steps to be taken if an outbreak is suspected or occurs. The numbers in the diagram refer to the explanatory notes below.

1. If the Veterinary Field Service (Ministry of Agriculture, Fisheries and Food, Tolworth) have been informed of a suspected case of foot and mouth, and they are reasonably confident of the vets diagnosis, they treat it as a confirmed case of foot and mouth. They prepare an A order, see Figure 6., which in

the event of confirmation of foot and mouth will be served to the infected farm stopping any movement of animals in and around the farm area. Further restrictions are also prepared (Protected Areas Order Act, 1938, as amended) for an area greater than 10 miles radius from the initial premises, which restricts animal movement from farm to farm and to the slaughter houses. Samples, in sealed containers, are taken by hand, to the Animal Virus Research Institute (AVRI) at Pirbright for diagnosis. An initial test takes only a few hours to perform, but if the result is negative a further test is done and this may take a further two days before the final result is known.

VFS also inform Met O 8a/Met O 2a of the possible outbreak of the disease. If the outbreak is an area which already has swinular vescular disease (SVD) or SVD is strongly suspected the Meteorological Office may not be informed until a positive diagnosis of foot and mouth has been achieved. SVD has clinical symptoms very similar to foot and mouth but it differs in two respects; firstly SVD effects only pigs and secondly its spread is not determined by the weather.

Either at the initial warning or subsequent confirmation of the disease the VFS will inform the Meteorological Office (Met O 8a or Met O 2a) of seven things:-

(a) Name of the farm where the outbreak is suspected or confirmed.
(b) Location of the farm (National Grid Reference).
(c) Bearing of the farm from the nearest town or map feature.
(d) Number and type of animals involved.
(e) Estimated length of infectious period, prior to diagnosis.
(f) Telephone number to which the meteorological data should be passed.
(g) Whether or not the ET should be set up.

2, 3, 4. Dependant upon the time of the initial contact from the VFS either Met O 8a/Met O 2a will contact as quickly as possible:-

(a) Met O 2a/Met O 8a.

(b) Appropriate Main Meteorological Office. For details see Figures 7 and 8.

(c) Met O 8a duty officer.

(d) Met O 10 (Notified by Met O 8a).

The appropriate Main Meteorological Office will then perform the analysis described in Appendix 2 to derive the sectors at risk from the primary source.

The details of the sectors will be passed, by telephone, to the number provided by the VFS, and also to Met O 8a. The working sheets, observations or charts used in the analysis will be kept for later discussion with ET meteorologist.

The meteorologist, on the ET, will make his way to the rendezvous taking if possible the prepared kit. Thereafter he will be based at the control centre.

3. Procedures at the control centre

When the duty officer is established at the control centre he should perform the duties listed below.

(a) Make contact with the local Meteorological Office.

(b) Check and update the preliminary risk sectors prepared by the Main Meteorological Office.

(c) Make a more detailed analysis of the wind and rain, in 24 hr periods back from the time of confirmation of foot and mouth disease.

(d) Examine for another source of the outbreak bearing in mind that the first confirmed case may not be the original source of the infection, but only the first detected.

(e) Brief the rest of the ET, usually first thing in the morning and at the end of the day, with the meteorological situation.

(f) If necessary ask for the Mobile Meteorological Equipment to be brought to the area.

(g) Continue updating the risk sectors until the ET is dispursed.

(h) Re-analyse the data if a secondary or subsequent case of foot and mouth is confirmed.

(i) Contact MET O 8a for advice or assistance or information at regular intervals.

Any comments or suggestions about this paper should be referred to the author.

Meteorological Office
Bracknell
March 1979

Figure 1. Approximate Numbers of Virus Required to Infect Cattle, Pigs and Sheep

	INHALATION	INGESTION
Cattle	Min 10 Normal 100-1000	100,000
Pigs	>10,000	>100,000
Sheep	1,000-10,000	NOT KNOWN

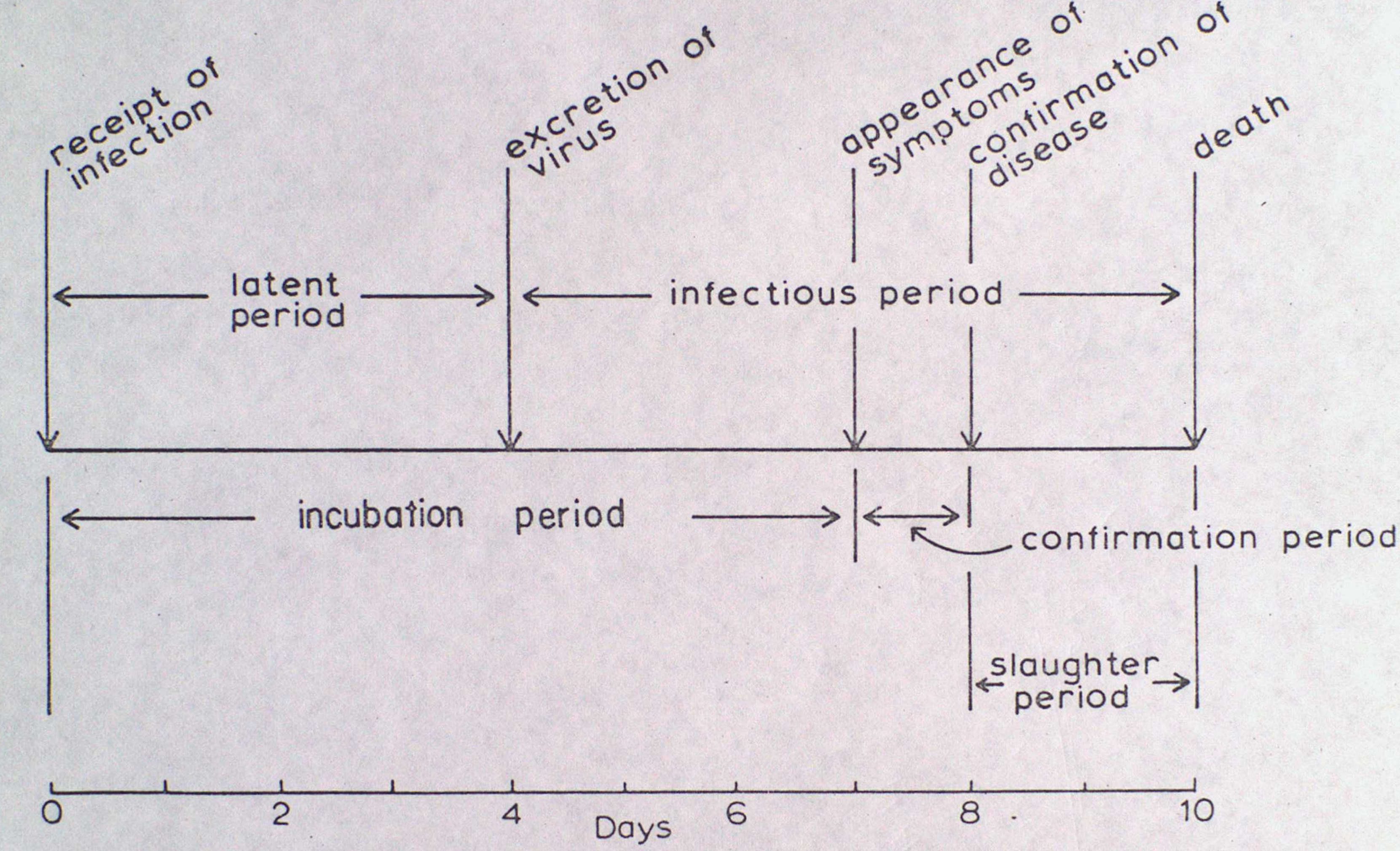

receipt of infection
excretion of virus
appearance of symptoms
confirmation of disease
death
latent period
infectious period
incubation period
confirmation period
slaughter period
0
2
4
6
8
10
Days

Figure 2. Approximate Time Scale for Foot and Mouth Disease.

Figure 3. Normal Maximum Levels of Virus Excreted as Aerosols

Animal	Normal Maximum Levels of Virus Excreted as Aerosols (min^{-1})
Roe Deer	300
Fallow Deer	150
Sika Deer	300
Red Deer	300
Muntjac Deer	300
Sheep	300
Cattle	250
Pigs	60,000

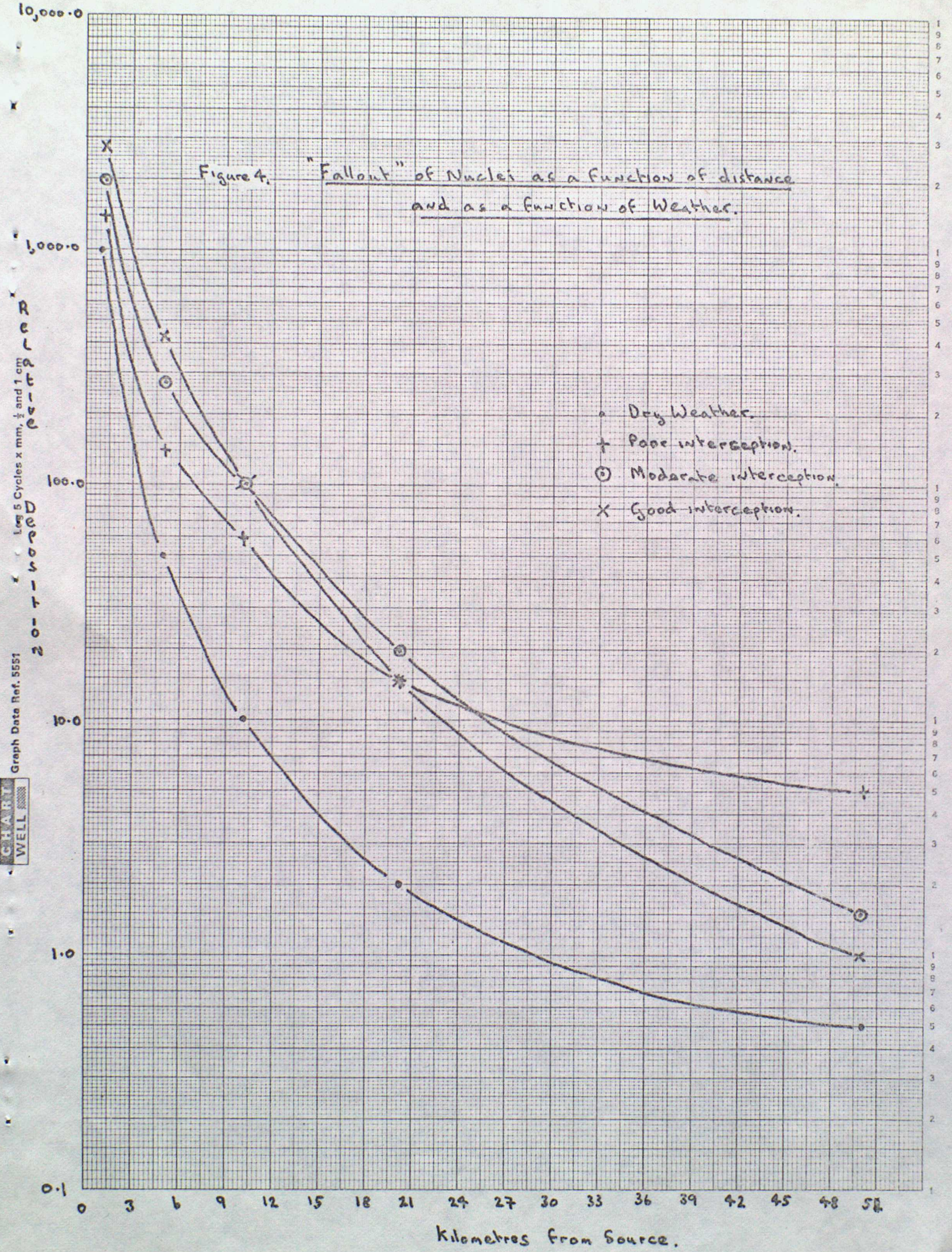
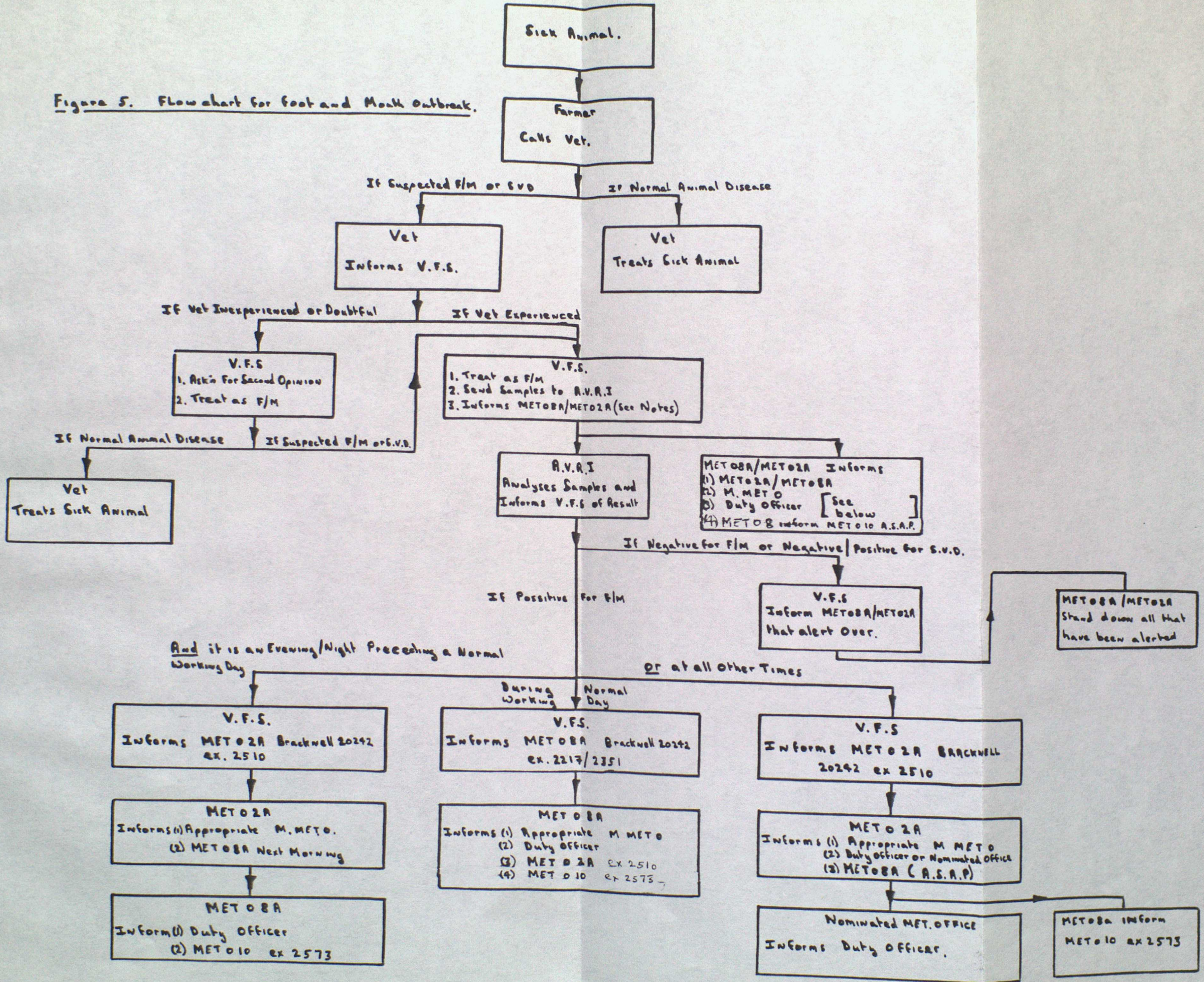


Figure 4. "Fallout" of Nuclei as a function of distance and as a function of Weather.

Figure 5. Flow chart for Foot and Mouth Outbreak.


Sick Animal.
Farmer
Calls Vet.
If Suspected F/M or SVD
If Normal Animal Disease
Vet
Informs V.F.S.
Vet
Treats Sick Animal
If Vet Inexperienced or Doubtful
If Vet Experienced
V.F.S
1. Ask's For Second Opinion
2. Treat as F/M
V.F.S.
1. Treat as F/M
2. Send Samples to A.V.R.I
3. Informs METO8A/METO2A (See Notes)
If Normal Animal Disease
If Suspected F/M or S.V.D.
Vet
Treats Sick Animal
A.V.R.I
Analyses Samples and Informs V.F.S of Result
METO8A/METO2A Informs
(1) METO2A/METO8A
(2) M.MET O
(3) Duty Officer [See below]
(4) MET O 8 ~~inform~~ MET O 10 A.S.A.P.
If Negative for F/M or Negative/Positive for S.V.D.
If Possitive For F/M
V.F.S
Inform METO8A/METO2A that alert Over.
METO8A/METO2A
Stand down all that have been alerted
And it is an Evening/Night Preceeding a Normal Working Day
During Working
Normal Day
or at all Other Times
V.F.S.
Informs MET O 2A Bracknell 20242 ex. 2510
V.F.S.
Informs MET O 8A Bracknell 20242 ex. 2217/2351
V.F.S
Informs MET O 2A BRACKNELL 20242 ex 2510
MET O 2A
Informs (1) Appropriate M. MET O.
(2) MET O 8A Next Morning
MET O 8A
Informs (1) Appropriate M MET O
(2) Duty Officer
(3) MET O 2A ex 2510
(4) MET O 10 ex 2573
MET O 2A
Informs (1) Appropriate M MET O
(2) Duty officer or Nominated Office
(3) METO8A (A.S.A.P)
MET O 8A
Inform (1) Duty Officer
(2) MET O 10 ex 2573
Nominated MET. OFFICE
Informs Duty Officer.
METO8a inform
METo10 ex 2573

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

DISEASES OF ANIMALS ACT, 1950
FOOT-AND-MOUTH DISEASE ORDER OF 1928 (ARTICLE 3)

FORM A
Notice Defining Infected Place

To________________________________

of________________________________

____

Figure 6. Form A

I, the undersigned, being an Inspector of the Ministry of Agriculture, Fisheries and Food, hereby give you notice as the occupier of the undermentioned premises that in accordance with the provisions of the Order of the Minister under which this Notice is served the undermentioned premises are hereby declared to be a Foot-and-Mouth Disease Infected Place for the purposes of the said Order, *and that the said premises accordingly become subject to the Rules set out overleaf. Any person infringing these Rules is liable to heavy penalties.*

This Notice remains in force until it is withdrawn by a subsequent Notice (Form B) served by an Inspector or Officer of the Ministry on the occupier of the Infected Place.

Dated this day of 19 .

(Signed)

Inspector of the Ministry of Agriculture, Fisheries and Food

Description of Infected Place, stating Parish

NOTE.—The Inspector is with all practicable speed to send a copy of this Notice to the Ministry, to the Local Authority, and to the police officer in charge of the nearest police station of the District.

Form FM 30 (P.T.O.

RULES TO BE OBSERVED ON A FOOT-AND-MOUTH DISEASE INFECTED PLACE

Rule 1. No animal shall be moved into or out of an Infected Place except with a licence granted by an Inspector or Officer of the Ministry.

Rule 2. No horse, ass or mule shall be moved out of an Infected Place unless it has been disinfected to the satisfaction of an Inspector.

Rule 3. No carcase shall be removed out of an Infected Place except with a licence granted by an Inspector or Officer of the Ministry and in accordance with such conditions as may be specified therein.

Rule 4. No live poultry, hare, or rabbit, or the carcase of any head of poultry, hare, or rabbit shall be removed out of an Infected Place except with a licence granted by an Inspector and in accordance with such conditions as may be specified therein.

Rule 5. No fodder, litter, dung, utensil, pen, hurdle, vehicle or other thing shall be removed out of an Infected Place except with a licence granted by an Inspector of the Ministry and in accordance with such conditions as may be specified therein.

Rule 6. All liquid manure, urine or shed washings shall be thoroughly disinfected to the satisfaction of an Inspector before being permitted to drain or escape from any shed, yard or other like place in which a diseased or suspected animal is or has recently been kept.

Rule 7. No person other than an Inspector shall enter or leave an Infected Place unless authorised by and in accordance with a written permit obtained from an Inspector.

Rule 8. Any person whosoever entering any shed, field or other place in which a diseased or suspected animal is or has recently been kept shall wear suitable overall clothing and boots which are capable of being disinfected and are approved by an Inspector, and shall before leaving such place thoroughly cleanse and disinfect such clothing and boots and also his hands.

Rule 9. Any Veterinary Inspector of the Ministry and any valuer or any veterinary surgeon or other person employed by the owner to treat the animals on any part of the Infected Place, shall, before entering the Infected Place, put on suitable overall clothing made of rubber or other material impervious to liquid, and rubber boots, and shall before leaving the Infected Place thoroughly cleanse and disinfect his overall clothing, rubber boots and hands.

Rule 10. Where an Inspector so directs any person upon leaving a shed, field or other place in which a diseased or suspected animal is or has recently been kept shall leave the overall clothing in such shed, field or other place, and shall thoroughly disinfect his hands and boots.

Rule 11. Any person tending a diseased or suspected animal shall not tend an animal not so diseased or suspected except with a written permit obtained from an Inspector of the Ministry.

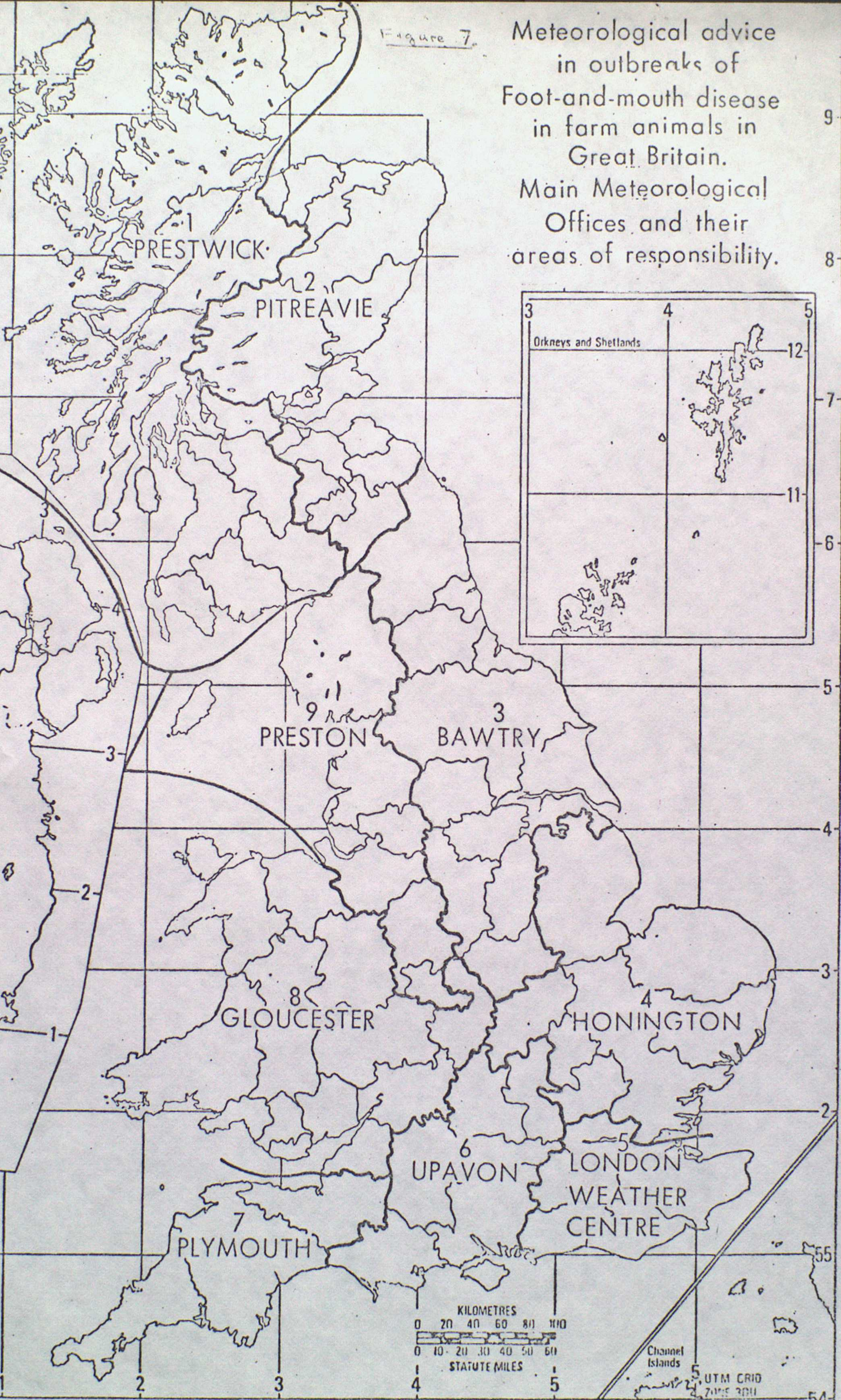
Rule 12. A receptacle containing an approved disinfectant shall be kept in some convenient place at all exits from an Infected Place as may be required by an Inspector. Fresh disinfectant shall be placed in such receptacles as often as may be directed by an Inspector.

Rule 13. The Minister, or an Inspector of the Ministry acting under his direction, may by notice to the occupier of any premises subject to these Rules require him to supply the disinfectant prescribed for use thereunder at the expense of the occupier.

Rule 14. Milk from any diseased or suspected animal shall not be moved from the Infected Place; and unless and until it has been boiled or otherwise sterilised it shall not be used for the food of animals. Any utensil in which such milk is placed before being so treated shall be thoroughly sterilised with boiling water before any other milk is placed therein. For the purposes of this Rule the expression "milk" shall be deemed to include whey, butter milk, and separated milk. This rule shall not interfere with an animal suckling young.

NOTE.—For the purposes of the Order an "animal" means any head of cattle, or any sheep, goat, other ruminating animal or swine.

Figure 7



Meteorological advice in outbreaks of Foot-and-mouth disease in farm animals in Great Britain. Main Meteorological Offices and their areas of responsibility.

1 PRESTWICK
2 PITREAVIE
3 BAWTRY
4 HONINGTON
5 LONDON WEATHER CENTRE
6 UPAVON
7 PLYMOUTH
8 GLOUCESTER
9 PRESTON
Orkneys and Shetlands
3
4
5
12
11
7
6
9
8
5
4
3
2
1
55
54
KILOMETRES
0 20 40 60 80 100
0 10 20 30 40 50 60
STATUTE MILES
Channel Islands
UTM GRID ZONE 30U

Figure 8.

METEOROLOGICAL ADVICE IN OUTBREAKS OF FOOT-AND-MOUTH DISEASE IN FARM ANIMALS IN GREAT BRITAIN

AREAS OF RESPONSIBILITY OF MAIN METEOROLOGICAL OFFICES

	Area (Counties)	M Met O
1.	Caithness, Sutherland, Ross & Cromarty, Inverness, Argyll, Dunbarton, Stirling, Renfrew, Lanark, Bute, Ayre, Wigtown, Kirkcudbright, Dumfries.	Prestwick
2.	Shetland, Orkney, Nairn, Moray, Banff, Aberdeen, Kincardine, Angus, Perth, Fife, Kinross, Clackmannan, West Lothian, Midlothian, East Lothian, Berwick, Peebles, Selkirk, Roxburgh.	Pitreavie
3.	Northumberland, Tyne and Wear, Durham, Cleveland, North Yorkshire, West Yorkshire, Humberside, South Yorkshire, Derbyshire, Nottinghamshire, Leicestershire.	Bawtry
4.	Lincolnshire, Norfolk, Northamptonshire, Cambridgeshire, Suffolk, Bedfordshire, Hertfordshire, Essex.	Honington
5.	Greater London, Surrey, Kent, West Sussex, East Sussex.	London Weather Centre
6.	Buckinghamshire, Oxfordshire, Berkshire Wiltshire, Hampshire, Dorset, Isle of Wight.	Upavon
7.	Somerset, Devon, Cornwall.	Plymouth
8.	Gwynedd, Clwyd, Salop, Powys, Dyfed, Hereford and Worcester, Warwickshire, West, Mid and South Glamorgan, Gwent, Gloucestershire, Avon.	Gloucester
9.	Cumbria, Lancashire, Merseyside, Greater Manchester, Cheshire, Staffordshire, West Midlands.	Preston

Appendix 1 FOOT AND MOUTH DISEASE - MOBILE OBSERVING UNIT

(1) CONTENTS OF BOXES

Box 1 of 6

Parts for anemometer head.

Box 2 of 6

Mast sections - 4 x 2" pipe sections.

Direction rod - 3 sections (2 inside one of the mast sections).

U-bolts and bolts for recorder base board (in plastic bag).

Cardboard box containing Allen keys, taper pins for direction rod and emery cloth for cleaning direction rod joints.

Box 3 of 6

Recorder, charts and box of inking system parts.

Box 4 of 6

Base board for recorder.

Base plate for mast.

Shoulder section for mast.

Guy wires, pegs and collar.

Cable for generator - recorder connection.

Spade.

Sledge Hammer.

Wrench.

Support for TSR funnel.

Distilled water.

Hand Lamp.

Instruction book for anemometer.

File of box contents and assembly notes.

Box 5 of 6

Dines TSR with clock and drum fitted.

Box 6 of 6

Screw drivers - large and small (one each).

Spanners - one ring, one open ended.

Spirit level.

Psychrometer - two thermometers fitted.

Spare thermometer.

Humidity slide rule.

Ink for recorders.

Charts for TSR.

Compass/Clinometer.

Padlock and 2 keys - for TSR.

Spare muslin for Psychrometer.

Clock - alarm.

Batteries for hand lamp (2).

Grease for mast sections.

The items underlined should be checked whenever the equipment has been used - or at six-monthly intervals by Met O 8a - and replacements requested as necessary from Met O 4.

(2) ASSEMBLY AND ERECTION OF ANEMOGRAPH

1. Grease threads of mast sections; clean and lightly grease joints of direction rod.
2. Position and level base plate for the mast so that the diagonal normal to the mast feet points north to south (true) - see attached chart for value of magnetic declination. (True north is magnetic north minus the value of westerly declination).
3. Remove cover plate - A on Figure 1 of drawings in Munro instruction book - and fix top (short) section of direction rod using Allen key. Connect cable to generator terminals (no polarity) and feed out through the side. Replace the cover plate.
4. Fix second direction rod section (thick), feed through top mast section (shortest one) and screw mast section to anemometer head.
5. Remove sleeve from mast section, slide guy collar and step onto this section and replace sleeve. Secure guy collar stop.
6. Connect lower direction rod section using one of the bronze taper pins - tap home but do not cut off as recommended in instruction book.
7. Screw in lower mast section, horizontal shoulder and mast legs.
8. Fix recorder base board to right hand leg of mast (facing head from bottom of mast) with U-bolts and bolt the recorder to the base board.
9. Adjust recorder position so that the direction rod can be coupled to the recorder. NB. It is possible to disengage the drive gears if the recorder is placed too low on the mast; the adjustment must be low enough however to keep the universal coupling from fouling the recorder case as the vane turns.
10. Support the top of the mast on the TSR crate and complete anemometer head assembly - vane, cups and cardinal pointers.
11. Rotate the collar until the north pointer is normal to the shoulder piece and clamp in position.

12. Remove perspex cover plate from direction drive gear (on left of recorder, behind the direction pen mounting). Ensure that the pen and direction rod gears are engaged (the bar locates on one of the pins on the gear wheel). Fit the direction pen temporarily and, holding the vane on one of the cardinal points, adjust the coupling until the pen indicates this direction. Tighten the coupling in this position.

13. Attach guys to collar and lift mast into position on base plate - ensure that the north pointer does point north. Tighten U-bolts.

14. Slack off guys, attach to pegs and drive pegs into the ground; tighten guys, using them to ensure that the mast is vertical.

15. Fit ink wells and pens to recorder as per instruction book.

16. Remove cover plate on terminal box on right of recorder and attach cable to GEN terminals - no polarity.

17. Start recorder - clock winding lever is on the right; start/stop lever for clock is on the left of the unit - a horizontal slide above the fast/slow regulating pin.

Appendix 2.

THE PREPARATION OF FOOT-AND-MOUTH DISEASE SECTOR DIAGRAM

In the initial stage of an outbreak of foot-and-mouth disease, before the Control Centre has started to operate, a simple analysis of the weather preceding the identification of the primary outbreak is urgently required.

2. The relevant information available from the veterinary authorities will be

   a. Site of primary outbreak;

   b. Period over which virus is thought to have been emitted from this source (a matter of days, generally 2 to 7).

The advice required is the spatial distribution of dry winds and precipitation-bearing winds during the significant period.

Method.

3. Use a double foolscap sheet of paper with columns headed 1, 2, 3 .....36 (surface wind direction in 10° sectors centred on 10°, 20°, 30°............360°) and calm. From the hourly observations of a nearby observing station, supplemented or replaced where necessary by reference to hourly charts, make an entry in the appropriate surface wind direction column, in red if precipitation or fog was occurring at the time of observation or during the previous hour, otherwise in black. Treat force 1 winds as calm.

4. If the emission period is given as a range, take the longest period. If there was continuous precipitation or fog at the beginning of this period, extend the analysis back to the beginning of the continuous precipitation or fog.

5. Three sectors can now be discerned from the analysis:

RED SECTOR - winds with precipitation or fog (red entries)

YELLOW SECTOR - dry winds (black entries)

GREEN SECTOR - the remainder.

To allow for the fact that winds are reported to the nearest 10 degrees, extend the RED and YELLOW sectors by 10 degrees at both extremities. In addition, extend both the RED and YELLOW sectors by 30 degrees of veer to allow for wind change with height. Sectors must cover the full 360°; there should be no gaps or overlaps. Single 10° sectors should not be specified separately, being added to the adjacent sector of greater importance. To avoid possible confusion, always give sector limits in clockwise order; if any sector includes one or more of the four cardinal points, name one of them e.g. "040° to 210° through south."

6. The advice is required in terms of bearing from the source so that for transmission the reciprocals of the directions obtained from the analysis should be given. The message should be passed to the required address by telephone in the following manner:

RED SECTOR	360°-110° through east
YELLOW SECTOR	300°-360° and 110°-140°
GREEN SECTOR	140°-300° through west.

To this should be added

No. of hours of precipitation or fog (number of red entries, including those under calm);

Amount of precipitation (in mm.) during the period of analysis, when available.

7. Examples are given on the next page.

Examples showing preparation of sector diagram

(i) Yorkshire outbreak, October 1960 (Actual)

Information Received: Outbreak at 1830 on 1 Oct 60 at Grid Ref SE 353 439 (7 miles NNE of Leeds) 24 to 48 hours old.

Nearest operational station is Dishforth.

Analysis to start at 1800 on 29 Sept 60 - 48 hours prior to outbreak.

	SURFACE WIND DIRECTION																																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	≤ F1
RED ENTRIES RAIN				/ 1		// 2	/ 1	~~////~~ // 7	~~////~~ /// 8	/// 3																											
BLACK ENTRIES NO RAIN					// 2	/ 1	~~////~~ / 6	~~////~~ ~~////~~ //// 14	/// 3	// 2																											

RAINFALL	29	30	1	TOTAL
21-09		0.6	0.3	)
09-21	tr	3.9		)4.8mm

ADVICE ISSUED Outbreak at: SE 353 439:-

PERIOD COVERED	29.1800 to 01.1900 GMT
RED SECTOR	210° to 320° through west
YELLOW SECTOR	NIL (entirely within Red Sector)
GREEN SECTOR	320° to 210° through east
TOTAL RAIN	4.8 mm
No. of OBSERVATIONS WITH RAIN	22

(ii) Sussex outbreak, June 1969 (Hypothetical)

Information Received:- Outbreak at 1500 on 24 June 69 at Grid Ref TQ 248 125 (6 miles NW of Brighton) 36 to 48 hours old
Use hourly charts for 22.1500 to 24.1500 GMT for surface wind analysis.

	SURFACE WIND DIRECTION																																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	≤ F1
RED ENTRIES RAIN	/// 3																												// 2		/// 3	// 2	// 2	~~////~~ // 7		/ 1	~~////~~ // 7
BLACK ENTRIES NO RAIN															/ 1			//// 4												// 2	// 2	/// 3		// 2			~~////~~ /// 8

ADVICE ISSUED Outbreak at: TQ 248 125:-

PERIOD COVERED	22.1500 to 24.1500 GMT
RED SECTOR	100° to 230° through south
YELLOW SECTOR	320° to 040° through north
GREEN SECTOR	230° to 320° through west and 040° to 100° through east
No. of OBSERVATIONS WITH RAIN	27